NPSAT1 ACS Hardware-in-the-loop Simulation

Introduction

NPSAT1 is a low-cost, technology demonstration satellite hosting a number of experiments. Commercial, off-the-shelf (COTS)-based technology will be implemented with custom designs to offer a low-cost command and data handling (C&DH) subsystem building on commercial, desktop PC architecture and standards-based specifications. In addition to an experimental C&DH subsystem, NPSAT1 will demonstrate the use of non-volatile ferroelectric RAM which is inherently radiation-tolerant and lithium-ion polymer batteries, state-of-the-art technology that will be employed offering high energy density (Watt-hr/kg) for space applications.

Experiments on-board NPSAT1 include two Naval Research Laboratory (NRL) payloads. The coherent electromagnetic radio tomography (CERTO) experiment and a Langmuir probe. The CERTO experiment is a radio beacon which, in concert with ground station receivers, is used to measure total-electron-content (TEC) in the ionosphere. The Langmuir probe will augment CERTO data by providing on-orbit measurements. The other experiments are of NPS origin. These include a novel design for a spacecraft computer board, a COTS visual imager (VISIM), and some micro-electromechanical systems (MEMS)-based rate sensors.

Description of Thesis Topic

The NPSAT1 spacecraft is a three-axis stabilized spacecraft using only magnetic torquers for actuators and a magnetometer as a sensor input. On-board processing will determine the local magnetic field vector using an orbit propagator. The NPSAT1 Matlab® Simulink® model is to be tested on a spherical air bearing to verify the analytical simulations. The scope of this thesis is to define and develop the test setup and perform the actual hardware-in-the-loop testing using a spherical air bearing. Work would include the design of the air bearing platform and implementation of the test setup.

Proposed Outline

- NPSAT1 Introduction
- ACS Design Description
- Test Setup
- Conclusions & Recommendations
- Appendix of Test Results and Test Data

Suggested References

- Memoranda following NPSAT1 PDR
- Matlab® Simulink® manuals / NPSAT1 models